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# Water quality in an unnamed branch of Pungoteague Creek, Bobtown Road and Hollies Church Road, VA.

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# Water quality in an unnamed branch of Pungoteague Creek, Bobtown road and Hollies Church Road, VA.

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VIMS ESL Technical Report #3

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**The Issue.** Previous sampling of the stream crossing Bobtown Road (Rt 178) near the intersection of Hollies Church Road (Rt. 620), had indicated high levels of nitrogen in the stream flow (Snyder and Ross, 2019). During a dry period, total nitrogen was determined as 21.932 mg/L, at the end of a rain event 9.56 mg/L was recovered, and during an extended wet period without major rainfall, a value of 18.26 mg/L was found. The lower value associated with the rain event suggested dilution of a ground water source. The proximity of the retired Accomack County Landfill upstream of the site triggered a higher resolution sampling of the stream in an attempt to isolate a source of the nitrogen loading.

**Methodology**. Sampling was conducted 11 March 2019, with sample points determined by the potential location of septic drainfields, stormwater inputs, bifurcations of the stream flow, and obvious ground water seepages into the stream (Figure 1). Sampling personnel included Richard Snyder, VIMS ESL and John Lauer, Accomack County.

Standard water quality sampling procedures were followed. The field technician used latex gloves to prevent contamination of samples. For each sampling event, an acid rinsed and sterilized 60 ml Nalgene polypropylene bottle was filled and rinsed three times with site water before final filling, capping, and placing on ice for transport to the laboratory. A field data sheet recorded the number of the sample, date and time of collection, and coordinates for each sample location recorded from GPS. Temperature, salinity, pH, and dissolved oxygen of the water was recorded from a handheld YSI meter. Field collection data were transferred to a MS Excel spreadsheet and is presented as Table 1. Samples were frozen at -20 deg C at VIMS ESL until transport to VIMS Gloucester Point Analytical Services for analysis of total nitrogen. Samples were delivered still frozen during custody transfer on 13 March. Details of the nutrient analysis method are presented in Appendix I. The analytical data were made available 19 March 2019 and were combined with the field data in a MS Excel spreadsheet, presented as Table 1. Data were plotted using ESRI ArcView GIS mapping software (Figures 1-4), and Kaleidagraph software (Figure 5).

**Results and Discussion**

Approximately one quarter inch of rain fell on the area in the 48 hours prior to sampling. The region has experienced record rainfall in the past year, resulting in saturation of surface soils and high recharge to the surficial aquifer. The stream was actively flowing through the culvert under Bobtown Road and along its full course through the forested stream valley, with active ground water seeps along the southern bank.

Values for pH did not vary appreciably over the sample locations, and are not presented as a GIS plot, but are presented in Table 1. Low salinity values reflected recent rainfall in ditch at the landfill site entrance (easternmost samples, LF1 and LF2 in Table 1; Figures 1 & 2), and in the samples taken in the upper reach of the forested stream bed and surface runoff collected in an elevated basin between the streambed and the capped landfill (LF13 and LF14 in Table 1; Figures 1 & 2.). All other samples were indicative of groundwater sources. Dissolved oxygen values indicated well aerated waters with the exception of a hypoxic site with 1.85 mg/L dissolved oxygen (LF12 in Table 1, Figures 1 & 3). This result triggered a restart and recalibration of the electronic meter, which provided the same result. Subsequent sample sites were well oxygenated based on the meter reading, so meter failure was ruled out. The site

(LF12) was down gradient of a monitoring well, and was chosen as a ground water seep site along the southern bank of the stream.

Total nitrogen levels in the stream were highest at the site where the low DO reading was obtained (LF12; 49.52 mg/L; Table 1; Figures 1 & 4) There did not seem to be an effect of location upstream or downstream of the residence on Bobtown Road as a potential septic drainfield contributor to stream nitrogen loading. All other samples appeared to be dilutions of FL12 with distance downstream (Figures 4 & 5). The combination of low DO, in a stream bank seep area, indicative of groundwater, and coinciding with the highest nitrogen value found, strongly suggests a groundwater source for the nitrogen loading to the creek at this relatively discrete sample location.

Dilution from the putative source at site LF12 is plotted as the nitrogen values as a function of longitude change, with longitude as a proxy for stream distance running east to west (Figure 5). For the downstream portion, an exponential decay indicating dilution from source was suggested by the plot ($R^2 = 0.724$).

Table 1. Field and analytical data for the stream samples taken 11 March 2019.

| Time | ID | Lat | Long | Temp deg C | pH | Salinity ppt | DO mg/L | TN mg/L |
|---|---|---|---|---|---|---|---|---|
| 9:50 | LF1 | 37.6473 | 75.7895 | 8.7 | 9.28 | 0.14 | 13.12 | 0.49 |
| 9:55 | LF2 | 37.6475 | 75.7892 | 8.2 | 8.12 | 0.21 | 5.90 | 1.01 |
| 10:12 | LF3 | 37.6498 | 75.7944 | 9.8 | 7.85 | 0.36 | 8.14 | 17.55 |
| 10:20 | LF4 | 37.6494 | 75.7936 | 10 | 7.71 | 0.35 | 8.06 | 19.40 |
| 10:25 | LF5 | 37.6493 | 75.7932 | 10.2 | 7.54 | 0.25 | 8.72 | 20.16 |
| 10:27 | LF6 | 37.6493 | 75.7929 | 10 | 7.43 | 0.36 | 6.56 | 26.24 |
| 10:31 | LF7 | 37.6493 | 75.7929 | 10.6 | 7.56 | 0.31 | 9.84 | 19.00 |
| 10:36 | LF8 | 37.6490 | 75.7928 | 10.2 | 7.72 | 0.34 | 10.56 | 19.23 |
| 10:50 | LF9 | 37.6491 | 75.7920 | 10.3 | 7.67 | 0.33 | 5.97 | 24.00 |
| 10:56 | LF10 | 37.6488 | 75.7915 | 10.5 | 7.4 | 0.34 | 6.41 | 28.12 |
| 11:00 | LF11 | 37.6490 | 75.7915 | 9 | 7.28 | 0.37 | 6.58 | 37.82 |
| 11:04 | LF12 | 37.6487 | 75.7911 | 10.8 | 7.09 | 0.49 | 1.85 | 49.52 |
| 11:10 | LF13 | 37.6484 | 75.7913 | 10.09 | 7.63 | 0.1 | 9.82 | 0.61 |
| 11:15 | LF14 | 37.6484 | 75.7905 | 10 | 7.32 | 0.15 | 7.58 | 2.88 |
| 11:24 | LF15 | 37.6487 | 75.7907 | 12.2 | 6.96 | 0.33 | 7.96 | 18.06 |


Figure 1. Sample locations along Hollies Church Road, west of the Accomack Southern Landfill site.


Figure 2. Salinity values recorded along the stream bed and in storm water runoff basins.


Figure 3. Dissolved Oxygen values at the sample locations.


Figure 4. Total nitrogen values in samples recovered from the site.

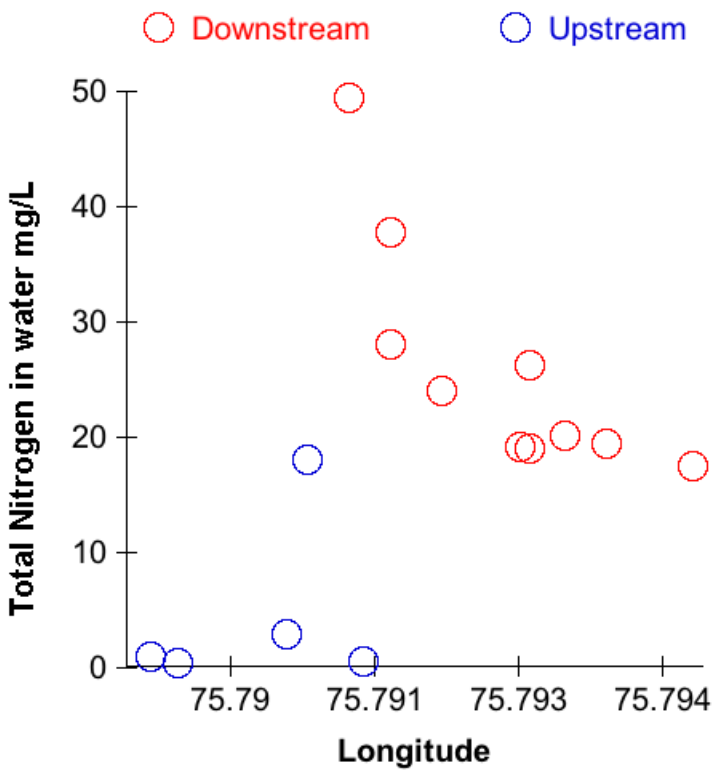


Figure 5. Nitrogen content of steam waters upstream and downstream of sample site LF12.

**References**

Snyder, RA and PG Ross. 2019, Water quality in southern Accomack County watersheds. VIMS ESL technical report #2. 21 pp.

**Appendix I. Analytical methods for nitrogen analyses.**

**Determination of Total Dissolved Nitrogen Skalar Auto Analyzer**
**ASC METHOD: 3005**
Document Control Number: 00076

**1.0 SCOPE AND APPLICATION:**

**1.1** This method describes the digestion procedure for total dissolved nitrogen (TDN) and total dissolved phosphorus (TDP) in fresh and estuarine surface waters by the alkaline persulfate oxidation technique. The dissolved fraction are aliquots of sample which have passed through a filter to remove particulates. The method is suitable for the determination of total nitrogen (TN) and total phosphorus (TP) with necessary precautions to ensure that particulates are fully digested. The applicable range for TDN and TN is 0.09-0.90 mg/L. The applicable range TDP and TP is 0.01-0.40 mg/L.

**2.0 SUMMARY OF METHOD:**

**2.1** The persulfate oxidation technique for nitrogen in water is performed under heated alkaline conditions, where all organic and inorganic forms of nitrogen are oxidized to nitrate. As the reaction proceeds, NaOH is consumed and the pH drops to < 2.2, which allows the oxidation of all phosphorus compounds to orthophosphate.

**2.2** An aliquot of digested sample is analyzed for nitrate and orthophosphate using automated colorimetric methods (Method 3001 and Method 3003, respectively) to produce total nitrogen and total phosphorus concentrations.